


We claim:

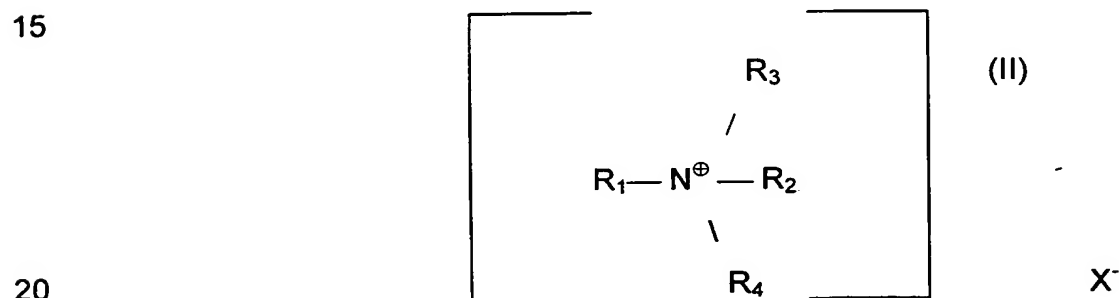
1. A method for improving the permeability of a petroleum-containing
5 formation, said method comprising treating said formation with a composition which comprises at least one nonionic surfactant and at least one cationic surfactant in an amount and a concentration effective to improve the permeability of said formation.
- 10 2. The method of claim 1 wherein said at least one nonionic surfactant is selected from the group consisting of alkanolamides, alkoxylated alcohols, alkoxylated amines, alkyl phenyl polyethoxylates, lecithin, hydroxylated lecithin, fatty acid esters, glycerol esters and their ethoxylates, glycol esters and their ethoxylates, esters of propylene glycol, sorbitan, ethoxylated sorbitan
15 polyglycosides and mixtures thereof.
3. The method of claim 2 wherein said at least one nonionic surfactant is an ethoxylated linear or or branched alcohol of the formula:



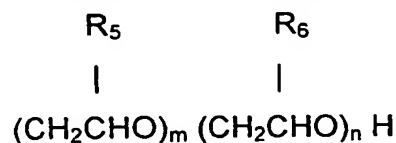
wherein R is a C₈-C₃₀ saturated or unsaturated, branched or straight chain alkyl, or alkylphenyl group of the formula A -  - O(CH₂CH₂O)_z, wherein A is a C₈-C₃₀ saturated or unsaturated, branched or straight chain alkyl, preferably a C₉-
25 C₁₂ linear or branched alkyl, and z is an integer of from 1 to 30.

4. The method of claim 3 wherein wherein A is a saturated or unsaturated, branched or straight chain C₉-C₁₂ alkyl.

5. The method of claim 3 wherein said ethoxylated alcohol is selected from the group consisting of laury alcohol ethoxylated with 3 moles of ethylene oxide(EO), coco alcohol ethoxylated with 3 moles of EO, stearyl alcohol ethoxylated with 5 moles of EO, mixed C₁₂-C₁₅ alcohol ethoxylated with 7 moles EO, mixed secondary C₁₁-C₁₅ alcohol ethoxylated with 7 moles EO, mixed C₉-C₁₁ linear alcohol ethoxylated with 6 moles EO, a C₉-C₁₁ alcohol ethoxylated with 4 moles EO, and mixtures thereof.
6. The method of claim 1 wherein said at least one cationic surfactant is selected from the group consisting of primary, secondary and tertiary amines, quaternary ammonium compounds, alkyl pyridinium salts and mixtures thereof.
7. The method of claim 6 wherein said at least one cationic surfactant is a quaternary ammonium compound of the general formula:

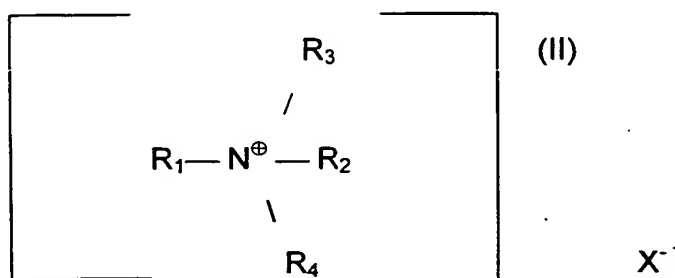


wherein R₁ is an saturated or unsaturated, branched or straight chain alkyl group having 8-22 carbon atoms, preferably, cocoalkyl; R₂ is a C₁ to C₆ alkyl group, 2-ethylhexyl, hydroxyethyl, hydroxypropyl, preferably methyl, ethyl or propyl; R₃ is selected from R₁, R₂ or a group of the formula:



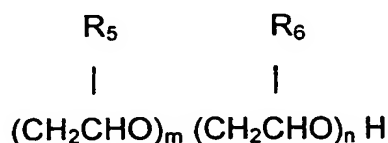
wherein R_5 and R_6 independently selected from hydrogen or a C_1 to C_6 alkyl group, and $m + n$ is an integer of from 2-80; R_4 is selected from R_2 or R_3 ; and X^- is an anion.

- 5 8. The method of claim 1 wherein said composition comprises a combination of
- (i) at least one ethoxylated linear or branched alcohol having from 8 to 18 carbon atoms reacted with 2 to 12 moles of ethylene oxide;
 - (ii) at least one quaternary ammonium compound of the general
- 10 formula:



wherein R_1 is an saturated or unsaturated, branched or straight chain alkyl group having 8-22 carbon atoms, preferably, cocoalkyl; R_2 is a C_1 to C_6 alkyl group, 2-ethylhexyl, hydroxyethyl, hydroxypropyl; R_3 is selected from R_1 , R_2 or a group

20 of the formula:

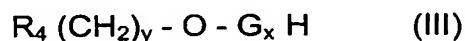


25 wherein R_5 and R_6 independently selected from hydrogen or a C_1 to C_6 alkyl group, and $m + n$ is an integer of from 2-80; R_4 is selected from R_2 or R_3 ; and X^- is an anion, and

- (iii) up to 30% by weight of at least one (poly) alkyl glucoside.

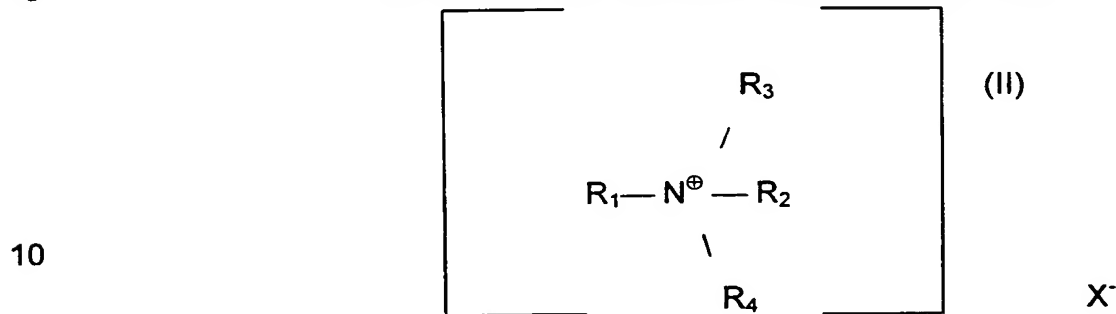
9. The method of claim 8 wherein said ethoxylated alcohol is selected from the group consisting of lauryl alcohol ethoxylated with 3 moles of ethylene oxide(EO), coco alcohol ethoxylated with 3 moles of EO, stearyl alcohol ethoxylated with 5 moles of EO, mixed C₁₂-C₁₅ alcohol ethoxylated with 7 moles
5 EO, mixed secondary C₁₁-C₁₅ alcohol ethoxylated with 7 moles EO, mixed C₉-C₁₁ linear alcohol ethoxylated with 6 moles EO, a C₉-C₁₁ alcohol ethoxylated with 4 moles EO, and mixtures thereof.
10. The method of claim 8 wherein R₁ is coco alkyl, m+n = 15, R₂ is methyl,
10 R₃ is H and X⁻ is Cl⁻ or methylsulfate.
11. The method of claim 8 wherein said quaternary ammonium compound is selected from the group consisting of stearyl methyl bis(ethoxy) ammonium chloride (12 moles EO), stearyl ethyl bis(ethoxy) ammonium ethyl sulfate (15
15 moles EO), tallow methyl bis(ethoxy) ammonium methyl sulfate (15 moles EO), tallow ethyl bis(ethoxy) ammonium methyl sulfate (15 moles EO), hydrogenated tallow methyl bis(ethoxy) ammonium chloride (15 moles EO), coco methyl bis(ethoxy) ammonium chloride (20 moles EO), and mixtures thereof.
- 20 12. The method of claim 8 wherein the HLB of the quaternary ammonium compound is from about 14.00 to 22.00.
13. The method of claim 8 wherein said composition additionally comprises up to 30% of a (poly) alkyl glycoside of formulae III or IV:

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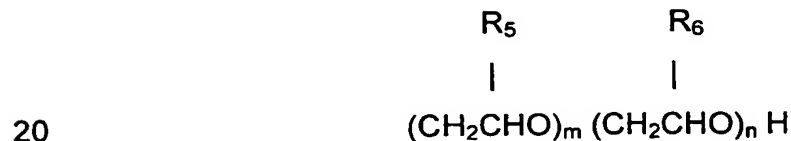


wherein R₄ is a straight or branched chain alkyl or alkenyl group having from 8 to 21 carbon atoms, G is a monosaccharide residue and x and y are selected from
30 a number of from 1 to 5;

- (i) at least one nonionic surfactant which is a ethoxylated linear or branched alcohol having from 8 to 18 carbon atoms reacted with 2 to 12 moles of ethylene oxide;
- (ii) at least one cationic surfactant which is a quaternary ammonium compound of the general formula:



wherein R₁ is an saturated or unsaturated, branched or straight chain alkyl group having 8-22 carbon atoms, preferably, cocoalkyl; R₂ is a C₁ to C₆ alkyl group, 2-ethylhexyl, hydroxyethyl, hydroxypropyl; R₃ is selected from R₁, R₂ or a group of the formula:




wherein R₅ and R₆ independently selected from hydrogen or a C₁ to C₆ alkyl group, and m + n is an integer of from 2-80; R₄ is selected from R₂ or R₃; and X⁻ is an anion, and

- (iii) optionally, at least one (poly) alkyl glucoside.

25

20. The composition of claim 19 wherein said ethoxylated linear or branched alcohol is of the formula:



wherein R is a C₈-C₃₀ saturated or unsaturated, branched or straight chain alkyl,
30 or alkylphenyl group of the formula A -  - O(CH₂CH₂O)_z, wherein A is a

C₈-C₃₀ saturated or unsaturated, branched or straight chain alkyl, preferably a C₉-C₁₂ linear or branched alkyl, and z is an integer of from 1 to 30.

21. The composition of claim 20 wherein wherein A is a saturated or
5 unsaturated, branched or straight chain C₉-C₁₂ alkyl.

22. The composition of claim 20 wherein said ethoxylated alcohol is selected from the group consisting of laury alcohol ethoxylated with 3 moles of ethylene oxide(EO), coco alcohol ethoxylated with 3 moles of EO, stearyl alcohol
10 ethoxylated with 5 moles of EO, mixed C₁₂-C₁₅ alcohol ethoxylated with 7 moles EO, mixed secondary C₁₁-C₁₅ alcohol ethoxylated with 7 moles EO, mixed C₉-C₁₁ linear alcohol ethoxylated with 6 moles EO, a C₉-C₁₁ alcohol ethoxylated with 4 moles EO, 15 mole ethoxylate of coco alkyl amine and mixtures thereof.

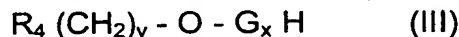
23. The composition of claim 19 wherein R₁ is coco alkyl, m+n = 15, R₂ is methyl, R₃ is H and X⁻ is Cl⁻ or methylsulfate.
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24. The composition of claim 19 wherein said quaternary ammonium compound is selected from the group consisting of stearyl methyl bis(ethoxy) ammonium chloride (12 moles EO), stearyl ethyl bis(ethoxy) ammonium ethyl
20 sulfate (15 moles EO), tallow methyl bis(ethoxy) ammonium methyl sulfate (15 moles EO), tallow ethyl bis(ethoxy) ammonium methyl sulfate (15 moles EO), hydrogenated tallow methyl bis(ethoxy) ammonium chloride (15 moles EO), coco methyl bis (ethoxy) ammonium chloride (20 moles EO), and mixtures thereof.

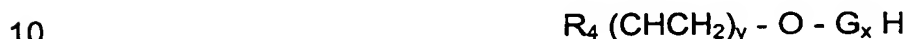
25. The composition of claim 19 wherein the HLB of the quaternary ammonium compound is from about 14.00 to 22.00.
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26. The composition of claim 19 wherein said composition optionally comprises a (poly) alkyl glycoside of formulae III or IV:



wherein R_4 is a straight or branched chain alkyl or alkenyl group having from 8 to 21 carbon atoms, G is a monosaccharide residue and x and y are selected from a number of from 1 to 5;



wherein R_4 is a straight or branched chain alkyl or alkenyl group having from 8 to 21 carbon atoms, R_5 is hydrogen or a straight or branched chain alkyl or alkenyl group having from 8 to 21 carbon atoms, G is a monosaccharide residue and x and y are selected from a number of from 1 to 5.

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27. The composition of claim 19 wherein said composition additionally comprises one or more solvents selected from the group consisting of water, methanol, ethanol, 1-propanol, 2-propanol and the like, glycols such as ethylene glycol, propylene glycol, diethylene glycol, dipropylene glycol, polyethylene glycol, polypropylene glycol, polyethylene glycol-polyethylene glycol block copolymers, and mixtures thereof.

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28. The composition of claim 19 wherein the ratio of said at least one nonionic surfactant to said at least one cationic surfactant is in the range of 4:1 to 1:4.

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29. The composition of claim 19 wherein said composition comprising said at least one nonionic surfactant to said at least one cationic surfactant is diluted to a concentration of from about 0.1% to about 10% by weight prior to injection into the formation.

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